

REPORT
ON THE
Agricultural Station, Orai, Jalaun,
OF THE
UNITED PROVINCES OF AGRA AND OUDH.
FOR THE YEAR ENDING JUNE 30th, 1907.



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FROM

W. H. MORELAND, Esq., C.I.E., I.C.S.,
DIRECTOR OF LAND RECORDS AND AGRICULTURE,
UNITED PROVINCES,

TO

THE CHIEF SECRETARY TO GOVERNMENT,
UNITED PROVINCES.

Dated Cawnpore, the 21st of November 1907.

SIR,

I HAVE the honour to submit the report on the Orai Agricultural Station for the year.1906-07. The report has been written by Mr. J. M. Hayman, Deputy Director of Agriculture ; the figures have been checked after printing.

2. The delay in submission is due to the press of practical work on cotton, which occupies the Deputy Director's time during the hot weather and the early part of the rains.

I have the honour to be,

SIR,

Your most obedient servant,

W. H. MORELAND,

Director.

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ERRATA to Report on the *Agricultural Station, Orai, for the year ending
June 30th, 1907.*

- 1 In page 1, line 6, read 'Bundelkhand' for 'Budelkhand'.
 - 2 „ 1, line 6, read 'of' for 'in' after the word examination.
 - 3 „ 1, last line, in the description of "Mar", read 'not' for 'never'.
 - 4 „ 1, line 7, in the description of "Kabar", read 'texture' for 'clayeness'.
 - 5 „ 2, in the statement showing Mechanical analyses of kabar and rakar soils, in the 3rd figure of sub-soil 6"—Rakar, read '32.12' for '3212'.
 - 6 „ 2, foot note, add the word 'note' before 'These soils &c.'
 - 7 „ 3, line 6, read 'one' for 'you'.
 - 8 „ 3, line 6, read 'considers' for 'consider'.
 - 9 „ 6, in the line next to Sub-group (a) read (1) for (b).
 - 10 „ 9, against No. 49 in column 'character and size of head', read ' $2\frac{1}{2}$ "—3" $\times$ $4\frac{1}{2}$ "' for ' $2\frac{1}{2}$ "—3 $\times$ $4\frac{1}{2}$ ".'
 - 11 „ 10, line 1st and 2nd of the note on Agave, read 'Agave lurida Syn. Vera-cruz' for 'Agave lurida Syn. vera-cruwz'.
 - 12 „ 10, line 3rd of the note on Agave, read 'successfully' for 'succesfully'.
 - 13 „ 10, line 5th of the note on 'Spineless Cactus', read 'Texas' for 'Texus'.
 - 14 „ 11, line 6th, omit the phrase "or rather perhaps never noticed badly attacked during that time".
 - 15 „ 11, line 9th, read 'since' for 'with' before 'taking'.
 - 16 „ 12, column 5th, against 'oats' under 'Parwa', read '12' for '16.'
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Report on the Agricultural Station, Orai, Jalaun, for the year ending June 30th, 1907.

CHAPTER I.

(1) PRINCIPAL OBJECTS OF THE STATION.

Cotton.—A botanical examination of cotton collected from different parts of Bundelkhand, and an examination in the proportion of the different types, their selection and trial from an economic point of view.

Wheat.—(I) An attempt at selection of rust resisting wheat grown under special conditions conducive to rust, conducted with seed obtained from all parts of the Provinces and sown on a considerable area.

(II) Trial of wheats bred at Cawnpore as to suitability to the Jalaun district and as regards rust resistance.

Linseed.—Work as above in connection with wheat. Dutch, Russian, Australian and country varieties are under trial, the former three for purposes of crossing should they prove, as claimed, rust resistant.

Juars.—Classification of Bundelkhand juars together with an experimental enquiry into the different district varieties most suitable for distribution as seed locally in times of scarcity.

Trial in the transference of juar, bajra, wheat and gram seed from other parts of the Provinces in case of importation being necessary in times of scarcity.

Kans.—Experimental trials in connection with *Kans* eradication.

Famine fodder.—Propagation of spineless cactus, etc., on waste land.

Trial of implements.

Miscellaneous.

(2) SITUATION, AREA AND SOILS.

The experimental station is situated about one mile from the Orai Railway Station, on the Great Indian Peninsula Railway, and about an equal distance from the Orai Collectorate.

The land has been acquired by Government and the necessary buildings have been erected by the Department. The whole area in possession is 81·01 acres, out of which 7·56 acres have been utilized for building purposes, &c. A distributary of the Betwa Canal supplies water to all parts, but is only available after the setting in of the rains and up to the month of December, and is liable in years of deficient rainfall to be insufficient. The construction of additional reservoirs at the head of the canal is expected largely to remedy these defects.

The site for experimental work was chosen as being easily approached by rail, near a railway station, and comprising blocks of land fairly representing the four principal soils of Bundelkhand, at the same time separated by no great distance from each other and the office buildings.

The four principal soils of Bundelkhand are *mār*, *kābar*, *pandū* and *rākar*.

Mar.—Is a strong black calcareous loam specially noted for its large deep cracks in the hot weather, its power of absorbing water during the rains and friability when being worked. Lumps of *mār* fracture with a distinct grain, showing small granules of lime and readily breaking down with time and light showers of rain. This soil is chiefly devoted to wheat or wheat and gram. By custom it is never generally manured and requires no irrigation in ordinary years.

Kabar.—Is a dark (usually) clay soil, lighter in colour than, and inferior in quality to, the best *mār*, and generally contains small black pellets which consist chiefly apparently of iron with smaller quantities of silica, manganese oxide, magnesia and lime. It may also contain small nodules of lime. Sticky and cohesive when wet, on drying it hardens and ploughs up with difficulty in large lumps which give a smooth fracture and do not readily break down.

It differs somewhat in colour and clayeness in different localities and sometimes receives such prefixes as *Lohā-kābar*, *Hara-kābar*, &c., in consequence. At the experimental station it is contiguous to *mār* and shades off gradually from this soil. It is devoted chiefly to wheat and gram, mixed, in the rabi and juar, cotton, &c., according to season in the kharif.

Mār block lies to the south-east, about a mile from the buildings in the village of Kuinyan.

Kābar block lies a few furlongs to the north-east of the buildings in the village of Ikhalapur.

Parwá block lies to the east of the buildings, about two miles off in the village of Minora Kalpi.

Rákar block lies a few furlongs to the north-west of the buildings and is also in the village of Ikhlaspur.

Pandua or Parwa.—Compared with *kábar* it is a light loam. It varies somewhat in colour and quality with its position, manuring and with different districts and may be *kháki*, brown, clayish coloured or even have a reddish tinge. Easy to work and responding readily to water and manuring it will grow most crops with these facilities. Without irrigation the principal rabi crop is gram and barley mixed.

Rakar (Stony).—No doubt so called in consequence of the presence of *kankar* nodules. It is found on slopes and along ravines and represents a degraded soil, the result of denudation by running water and the deposit elsewhere of its best material. It varies somewhat with the kind of soil from which it is derived and the amount of erosion to which it has been subjected. Thus we have *mota-rákar* and *patla-rákar*, terms sometimes used loosely, sometimes represented by other names in different places, but which define clearly enough differences in quality that undoubtedly exist. It grows poor crops of *juar* and *bajra* in the *kharif*, or gram and the poorer pulses in the *rabi*.

The following shows the complete analyses carried out by Dr. Leather, Imperial Agricultural Chemist, of *már*, *parwá*, *kábar* and *rákar* soils.

Constituents.	<i>Már.</i>		<i>Parwá.</i>		<i>Kábar.</i>		<i>Rákar.</i>	
	Surface soil 6".	Sub-soil 6".	Surface soil 6".	Sub-soil 6".	Surface soil 6".	Sub-soil 6".	Surface soil 6".	Sub-soil 6".
Insoluble silicates and sand ...	74.74	73.96	86.38	84.28	75.93	75.49	76.91	71.35
Ferric oxide. ...	5.59	5.78	3.26	4.25	5.55	5.79	4.74	5.60
Alumina ...	9.23	8.57	5.42	5.54	9.45	9.68	7.43	8.33
Lime ...	2.38	2.49	.69	.75	1.78	1.42	2.96	4.84
Magnesia ...	1.40	2.05	.71	.66	1.27	.96	1.26	1.41
Potash ...	.81	.74	.52	.45	.86	.90	.65	.74
Soda ...	.55	.15	.22	.68	.23	.04	.16	.35
Phosphoric acid ...	.30	.08	.03	.02	.07	.07	.10	.10
Sulphuric acid ...	.007	.008	.007	.007	.02	.02	.02	.03
Carbonic* acid ...	.09	.35	.09	.02	.28	.22	.56	1.07
Organic matter and combined water.	4.90	5.82	2.67	3.34	4.66	5.41	5.21	6.08
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total nitrogen% ...	.04	.04	.04	.03	.039	.031	.036	.028
Available phosphoric acid% ...	.010	.008	.014	.007	.0068	.0049	.0042	.0004
Available potash% ...	.015	.016	.011	.008	.031	.009	.015	.020
*Equivalent to calcium carbonate%...	...	...	...	...	.63	.49	1.27	2.45

The following shows the mechanical analyses of *már* and *parwá* soils and sub-soils :—

Diameter.			<i>Már.</i>		<i>Parwá.</i>	
			Surface soil.	Sub-soil.	Surface soil.	Sub-soil.
Sand	> .25	M. M. ...	1.85	2.0	.3	.7
	.25—.032	" ...	31.90	28.45	46.30	43.9
	.032—.016	" ...	35.1	35.7	30.05	30.8
	.016—.008	" ...	7.1	9.75	6.40	7.25
	.008—.004	" ...	7.6	8.4	5.75	6.0
	.004—.002	" ...	11.0	11.1	8.00	7.9
	< .002"	" ...	1.35	1.05	.85	.85

The following shows the mechanical analyses of the *kábar* and *rákar* soils and sub-soils :—

Diameter (millimeter).			<i>Kábar.</i>		<i>Rákar.</i>	
			Surface soil 6".	Sub-soil 6".	Surface soil 6".	Sub-soil 6".
Sand	> .16	M. M. ...	3.07	4.04	6.19	6.20
	.032—.16	" ...	33.95	34.79	37.89	30.81
	.016—.032	" ...	33.03	31.65	31.75	32.12
	.008—.016	" ...	9.70	9.54	7.85	9.80
	.004—.008	" ...	6.90	6.78	5.54	7.54
	.002—.004	" ...	4.51	5.01	4.11	5.32
Clay	< .002	" ...	.68	.66	.55	.48

* These soils contain comparatively very little fine material.

CHAPTER II.

TRIALS OF DIFFERENT VARIETIES OF CROPS.

1. **Maize.**—Two varieties of maize were tried, *i.e.* Jaunpuri and Cawnpore *desi* on *pandua* soil, with manure. Owing to excessive and untimely rain both failed.

2. **Cotton.**—The outturns in the following statement show much variation when you consider, as pointed out last year, that with the exception of *Gwalior* and *Bani* the remaining cottons are merely similar mixtures of red and white flowered plants retained under their district names and sown for purposes of selection. But while it may be allowed that Jalaun cotton has perhaps adapted itself to Jalaun conditions, much must be put down to the differences of plots and the chances of sowing with the rains. With the experience gained here and at Cawnpore the conclusion arrived at is that there are no distinct provincial varieties known under local names which show any signs of being advantageously introduced, and that any improvement must be made by some fortunate selection or some equally fortunate cross.

Statements showing unginned outturn of cottons in pound per acre.

1906.					1907.				Remarks.
Serial No.	Name of variety.	Outturn in lbs per acre.			Outturn in lbs per acre.				
		Parwá.	Kábar.	Már.	Parwá.	Kábar.	Már.	Bákar.	
1	Jalaun kapas ...	301	287	278	689	182	61	184	
2	Do. kapasi ...	309	469	...	435	179	...	...	
3	Kirwee No. 1 ...	231	...	...	471	...	...	...	
4	Do. No. 2 ...	333	...	...	394	...	...	...	
5	Etawapar ...	374	...	...	379	...	...	...	
6	Gwalior Bagchini ...	474	...	...	410	...	...	...	
7	Bani ...	350	...	...	194	...	...	...	

Bani versus Jalaun.—The outturns of *Bani* this year and last show that, as experienced at Cawnpore, it is not suitable to Jalaun: not only is the outturn poor, but the crop is late and the plants are badly attacked by insects.

Statement showing outturns of Jalaun and Bani Kapas duplicated on 4 Parwa plots in 1907.

Name of variety.	Outturn in lbs. per acre.	Remarks.
Bani ...	97	Bani is late and very badly attacked by insects.
Jalaun Kapas ...	291	
Bani ...	71	
Jalaun Kapas ...	262	

Selection.—A few trees showing evidence of producing superior lint and percentage of lint to seed have been selected. Owing to uncertainty of rainfall and the want of irrigation before the rains the seed has been planted at Cawnpore. After examining some thousands of trees, the resulting selections are too precarious to trust to such chances as occur in Jalaun at present.

3. **Ground-nuts.**—Five varieties, Madras, Spanish, Virginia, Pondicherry and Japanese were tried on *parwá*. I was under the impression that the crop was new in Bundelkhand (but found later that this was not quite so) and thought that perhaps with increased facilities for irrigation it might succeed. One of the greatest drawbacks seemed likely to be white-ants, but so far they have done little damage. Owing to the *Bamba* being closed, a very necessary watering in October was unable to be given and the soil was so hard that many fruiting shoots were unable to penetrate the ground. However, the results are not unpromising, but one must expect injury from rats and white-ants at times. The nuts sold at eight seers per rupee and at 15 maunds to the acre would fetch Rs. 75.

A small quantity was sown in *már*, but, as seemed very likely, they were not successful, the nuts becoming rotten.

I find in Ledger No. 15 of 1893 that the nuts have been grown in Banda and were considered only suitable as a garden crop. This would doubtless be so in this district without irrigation.

Statement showing outturn of ground nuts in pounds per acre.

Serial No.	Name of variety.	Outturn on <i>Parwá</i> .	Remarks.
1	Madras ...	881	
2	Spanish pea nut ...	1,107	
3	Virginia ...	1,586	
4	Pondicherry ...	1,332	
5	Japanese small ...	725	

4. **Rice.**—A few varieties were again sown on *parwá* and *kábar*: the transplanted ones altogether failed owing to there being no water available in the *Bamba* shortly after trans-planting and to the attacks of rice sapper. The broadcasted ones were also badly damaged by the rice sapper and gave a very poor outturn.

The experiment has been closed, it being evident that other crops are more reliable and more easily raised on the upland and that the conditions of Jalaun are too unfavourable for rice-growing except, perhaps, for the coarse and common *sathi*, and that only on lowlying places which could grow hardly anything else.

5. **Wheat.**—A wheat named *F(S)*² received from the late Mr. Farrer as an early ripening wheat and acclimatized and selected in the past at Cawnpore was compared with the local *kathia* wheat on *már* and *kábar* soils. The year was favourable to rust and there appeared no difference between the two in this respect.

The outturns are as follows:—

		<i>Már.</i>		<i>Kábar.</i>	
		Irrigated.	Unirri-gated.	Irrigated.	Unirri-gated.
<i>Kathia</i>	...	730	685	590	643
<i>F (S)</i> ²	...	520	553	544	330

CHAPTER III.

CLASSIFICATION OF BUNDELKHAND JUARS.

Last year the juars were placed in groups according, when ripe, to the size, shape and hairiness of their glumes and the more or less hidden or exposed grain; and into sub-groups according as the grain was single or double, distinctly hard or more or less soft, and the upper portion of the glumes hairy or nearly hairless and shiny.

I find no reason at present to change these groups, but after examining and comparing the progeny this year I am able to bring the types closer together and show more clearly which juars received under different names are really the same. The colour of the glumes was at first a most confusing character, as a head with yellow or purple or red glumes presented such striking differences. But it is evident that when juars are sown, mixed as they are often to some extent, cross-fertilization takes place, producing a large number of intermediate forms, especially with regard to the shades of colour of the grain and glumes.

An interesting fact from the botanical point of view is that up to the time of ripening the whole of the glumes in group C are hairy, but when full ripe I find the hairs easily rub off. This gradually occurs when the swollen grain brings the glumes in contact and friction takes place in consequence of wind and in the process of harvesting. When the grain is inclined to be flat and not very large, as in *Aukhmundi*, there is less contact and the glumes often remain somewhat more generally hairy. But it is not so apparent why the hairs nearly disappear from

the upper part of the glumes of sub-group (b) of group C. The size of the grain unless very distinct, such as very small or extra large, is not a character of value. Single grains occur in all the double-grained heads near the top.

The juars for the sake of reference are arranged under the districts from which they come, as well as grouped according to their botanic characters. No outturns are given, as it is quite impossible to grow such a large number of juars on anything but small areas, and these scattered far apart are doubly unreliable.

Juars arranged according to the district from which they were received.

<i>Jalaun district.</i>				<i>Banda district—(concluded).</i>			
Andhari ...	Group	A.1		No. II from Charka	Group	C.23	
Safed Dohra ...	"	C.44		Desi ...	"	C.45	
" Eksara ...	"	C.27		Daunra ...	"	C.8	
Bauna Dohra } Jhalra }	"	C.32		Badimasia ...	"	C.6	
Lal Dohra ...	"	C.51		Bansmatia ...	"	C.15	
Kumbhara } Pira Dohra }	"	C.30		Ankhumdi ...	"	C.1	
Jhalra } Kumbhara }	"	C.38		Mithui ...	"	C.9	
Pira Dohra } Bauna Dohra }	"	C.32		Wazir ...	"	C.9a	
Jhalra } Lal Dohra ...	"	C.51		Alagardi ...	"	C.49	
Lal Eksara ...	"	C.21		Kanchapi ...	"	C.37	
Lal Eksara } Jhalra }	"	C.19		Arora ...	"	C.16	
Lalia Eksara } Jhalra }	"	C.20		Jogia ...	"	C.18	
<i>Hamirpur district.</i>				Mahdaiya ...	"	C.40	
Lalo or Jogan ...	"	C.17		Julawan ...	"	C.40a	
Bansmati ...	"	C.2		Dugdi, white ...	"	C.48	
Dugdi ...	"	C.34		Wani ...	"	C.25	
Arara ...	"	C.41		Dol ...	"	C.3	
Bauni ...	"	C.50		Mandraji ...	"	C.31	
Ghasan or Kumbhara ...	"	C.39		Bhadaili ...	"	C.31a	
Baidra ...	"	C.46		Gogla ...	"	C.5	
<i>Banda district.</i>				Kirwi ...	"	C.35	
Dadri ...	"	C.24		Jogni ...	"	C.22	
Charka ...	"	C.7		Sukhlal ...	"	C.29	
No. I from Charka ...	"	C.10		Karsia ...	"	C.43	
				Kashmir ...	"	C.12	
				Khowa ...	"	C.14	
				Gudlari ...	"	C.26	
				Ujar ...	"	C.47	
				Dugdi ...	"	C.36	
				Dugdi, yellow ...	"	C.42	
				Makka ...	"	C.4	
				Bauni ...	"	C.33	
				Badri ...	"	C.13	
				Dudhnagar ...	"	C.1a	
				From Dudhnagar ...	"	C.11	

Juars grouped according to their botanical characters.

The following standard has been taken in referring to the size of the grain :—

10 seeds =	6 to 7 grains =	extra large.
" =	5 to 6 "	= large.
" =	4 to 5 "	= medium.
" =	3 to 4 "	= small.
" =	2 to 3 "	= very small.

Group A.—Glumes reaching 15 m.m. in length, uniform except at edges, thin there, exceeding the grain by 2.5 to 3 m.m. but allowing the latter when ripe to be seen, hairy on lower two-thirds, tips glabrous, pointed and often slightly incurved, veins distinct, grain single, hard plump. Awns always present to a greater or less extent.

	Name of variety.	Locality.	Colour of grain.	Size of grain.	Character and size of head.	Colour of glumes.	Plant.	Threshing.	Remarks.
1	Andhari 1906.	Jalaun.	Whitish-yellow.	Large.	Compact to loose 3½" × 8"	Yellow.	Tall.	Somewhat easy.	

Group B.—Glumes 11 to 12 m.m. long barely equalling grain or as slightly exceeding it, uniform except at edges, thin there, hairy on lower two-thirds, tips glabrous oval or slightly oblanceolate, veins distinct, grain exposed rather soft. Awns always present to a greater or less extent.

	Name of variety.	Locality.	Colour of grain.	Size of grain.	Character and size of head.	Colour of glumes.	Threshing.	Remarks.
1	Miscellaneous 1906.	Unknown.	White.	Medium	Compact to loose.	Purplish	Somewhat difficult.	1907 progeny showed variation in colour of glumes.
2	Ghush 1907.	Banda ...	White	Small ...	Compact 2" × 6"	Purple...	...	Collected 1906.

Group C.—Glumes not exceeding grain, generally much shorter and distinctly exposing it, hard below, thin and depressed in the upper part, broad below the point of demarcation and frequently transversely creased or wrinkled, edges more or less ultimately ragged. Awns always present to greater or less extent.

Sub-group (a) Glumes with conspicuous hair on them in the upper part.

(b) Grain single medium hard, softer when white, glumes yellow or red or with intermediate colours probably due to crossing in most cases.

	Type.	Name of variety.	Locality.	Colour of grain.	Size of grain.	Character and size of head.	Plant.	Threshing.	Remarks.
1	Sweet smelling, glumes about equal to grain, grain flattish white.	Ankhumdi...	Banda ...	White ...	Medium	Loose 3"—4" × 9"—10".	Tall ...	Somewhat difficult.	Nos. 1, 1a and 2 have all fine heads, rather sweet smelling and similar in appearance and character of panicle. The glumes of No. 1 generally equal to the grain, hence the name Ankhumdi, in the other two they are inclined to be shorter and the grain more exposed. Ankhumdi may be taken as the type and the other two as possibly crosses or a similar variety with shorter glumes.
1a		Dudhnagar...	Do. ...	Do. ...	Large ...	Loose 3"—4" × 9"—10".	Rather tall.	Somewhat difficult.	
2		Bansmati ...	Hamirpur.	Do. ...	Do. ...	Compact 3½" × 7".	Short thick.	Somewhat easy.	
3	White plump grain, glumes yellow with very distinct wrinkle.	Dol ...	Banda ...	White ...	Large...	Compact to loose 3"—4" × 6"—8".	Tall ...	Somewhat easy.	Nos. 3 to 9 inclusive have all fine heads and may be considered as belonging to one variety having as the type a white plump grain which causes a very distinct transverse wrinkle in the glumes. Those showing a somewhat flat grain last year have not retained this character but given grain in part of the type above. Thus minor differences in the shape of the grain and in the colouration of the glumes which may give them a distinct difference in appearance are found from the progeny to be quite variable characters. The typical colour of the glumes is probably yellow and a reddish or purplish tinge; may indicate a cross with the red grained juars at sometime. The shortness of the plant in Badmasia was probably due to situation; if this proves not to be so, it will then have to be placed separately.
4		Makka ...	Do. ...	Do. ...	Do. ...	Compact-spreading 3"—4" × 7"—8".	Do. ...	Somewhat easy.	
5		Gogla ...	Do. ...	Do. ...	Do. ...	Compact to loose 3"—4½" × 7"—8".	Do. ...	Somewhat easy.	
6		Badmasia ...	Do. ...	Do. ...	Medium	Compact to loose 3½" × 7"—8".	Short ..	Somewhat difficult.	
7		Charka ...	Do. ...	Do. ...	Do. ...	Compact to loose 2½" × 6".	Tall thick	Somewhat easy.	
8		Daunra ..	Do. ...	Do. ...	Large ...	Compact to loose 3"—3½" × 6"—7".	Ditto ..	Somewhat easy.	
9		Mithui ...	Do. ...	Do. ...	Medium	Loose 5"—7" ...	Tall ...	Somewhat easy.	

	Type.	Name of variety.	Locality.	Colour of grain.	Size of grain.	Character and size of head.	Plant.	Threshing.	Remarks.
10	Large flat grain.	Wazir 1906	Banda ...	White ..	Large flat	Loose ...	...	Somewhat easy.	These appear to belong to a distinct variety with large flat grain. In 10 the grain is white in 11 slightly yellow, the glumes in both are reddish. The real type of grain is probably white but there may be a yellowish grained variety. The colour of the glumes seems to indicate a cross in both specimens.
11		No. 1 from Charka 1906	Do.	Yellowish white.	Large flat.	Loose 3" x 7" ...	Tall thick	Somewhat easy.	
12	Large heads, single yellow grain and yellow glumes.	From Dudhnagar ...	Banda ...	Yellowish-white.	Large ...	Loose ...	Tall ...	Somewhat easy.	Nos. 11 to 15 both inclusive are a yellow grained type of juar. Nos. 11, 12 and 13 had grain last year somewhat flat. No. 12 threw some yellowish white grained heads this year. All these plots got water logged and spoilt from excessive rain; the specimens are too poor to judge from exactly but they all look closely to belong to one variety with large heads and single yellow grain in which some crossing has taken place.
13		Kashmir ...	Do. ...	Yellow	Do.	Compact 4" x 7" - 3"	Do. ...	Somewhat difficult.	
14		Badri ...	Do. ...	Yellow	Do.	Compact to loose 3" - 4" x 7"	Short thick (tall).	Somewhat easy.	
15		Howa ...	Do. ...	Yellow...	Medium	Compact to loose 3" - 4" x 7"	Tall ...	...	
16		Bansmatia ...	Do. ...	Yellow...	Small ...	Compact 3" x 6"	Do. ...	...	
17	Red grained and red glumed juars.	Lal Jogan ...	Hamirpur.	Red (base lighter coloured.)	Large ...	Compact to compact 2½" x 3" x 6"	Tall thick.	Easy ...	Nos. 17 to 26 are all types of red grained and red glumed juars. They exhibit two, possibly three, varieties; no. 17, with red medium grain and threshing very easily; no. 18, with red extra large grain and threshing somewhat difficult; no. 19, with red small grain and threshing distinctly with difficulty. All the rest appear mere crosses with a varying amount of red giving shades of a pink or pinkish white colour, sometimes producing progeny with grain of similar colour and sometimes of lighter shades. The greatest variation being in no. 24 which produced heads with totally white grain and similar in appearance to nos. 8 to 9 and one head with pinkish grain on one side and whitish on the other.
18		Jogia 1906....	Banda ...	Red (base light coloured.)	Do. ...	Compact to loose 3" x 5"	Tall ...	Somewhat difficult.	
19		Lal Eksara Jhalra ...	Jalaun ...	All red...	Medium	...	Short ...	Difficult.	
20		Lalya Eksara Jhalra ...	Do. ...	Pinkish, red, base yellow.	Do. ...	Compact to compact 2½" x 4"	Do. ...	Somewhat difficult.	
21		Lal Eksara ...	Do. ...	Red (base slightly yellow.	Do. ...	Compact to compact 3" x 5"	Do. ...	Somewhat easy.	
22		Jogni ...	Banda ...	Pink ...	Large ...	Loose 2" - 3" x 7" - 8" ...	Tall ...	Somewhat easy.	
23		No. II from Charka	Do. ...	Pinkish-white	Do. ...	Compact to loose 3" - 4" x 6" - 7"	...	Very easy	
24		Dadri ...	Do. ...	Pinkish	Small ...	Compact to loose 2" x 7"	Tall ...	...	
25		Wani ...	Do. ...	Pinkish	Do. ...	Compact 3" x 6"	Short thick.	Very easy	
26		Gudlari ...	Do. ...	Pinkish white.	Large ...	Compact to loose 3" x 7"	Tall ...	Easy ...	

Type.	Name of variety.	Locality.	Colour of grain.	Size of grain.	Character and size of head.	Plant.	Threshing.	Remarks.
(2)—Grain single distinctly hard and transparent.								
27	Sufed Eksara	Jalaun ...	Pearly-white.	Medium	Compact 3 " × 6 ".	Short, thick.	Difficult.	Nos. 27, and 28, the grain of progeny does not appear so distinctly hard as in parents but retain their pearly white and pearly yellow colour.
28	Miscellaneous	Un-known.	Pearly-yellow.	Large ...	Compact ...	...	Some what difficult.	
(3)—Grain double medium hard (a few single grains always occur).								
29	Sukh Lal	...Banda ...	Yellow	Medium	Loose 3"-4" × 9"	Tall ...	Easy.	Nos. 29 to 35, both inclusive, all have fine heads and are all evidently one variety, having yellow double-grained large heads as the type.
30	Kum bhara Pira Dohra Jhalra.	Jalaun ...	Do. ...	Do. ...	Loose 3 " × 9"	Tall thick	Easy.	
31	Yellow double-grained large heads with yellow glumes.	Mandaraji ...	Do. ...	Do. ...	Compact to loose 3½ " × 7"	Tall ...	Easy.	
31a		Bhadaili ...	Do. ...	Do. ...	3 " × 7 "	...	...	
32		Bauna Dohra Jhalra.	Do. ...	Do. ...	Compact to loose 3½ " × 7"	Short ...	Somewhat difficult.	
33		Bauni ...	Do. ...	Do. ...	Compact to loose 3½ " × 6"-7"	Tall ...	Easy.	
34		Dugdi ...	Do. ...	Do. ...	Loose 3" × 7" ...	Do. ...	Somewhat difficult.	
35		Karwi ...	Do. ...	Do. ...	Loose 3" × 7"-8"	Do. ...	Easy.	
36		Dugdi ...	Yellow...	Medium	Compact to loose 3" × 5"	Tall ...	G r a i n s of head almost altogether eaten by rats.	Nos. 36 to 40, inclusive, are also a yellow double-grained type of Juar. They appear to have short rather compact heads but were poorly grown. With well developed specimens they may possibly develop heads the same as Nos. 29 to 35 and prove all one variety.
37		Kanchapi ...	Do. ...	Small ...	Compact to loose 2½ " × 4½ "	Do. ...	Easy.	
38	Uncertain.	Kum bhara Pira Dohra.	Do. ...	Medium	Compact 3" × 5"	Short ...	Easy.	
39		Ghasua or Kumbhara.	Do. ...	Small ...	Compact to loose 3" × 5"	Do. ...	Somewhat difficult.	
40		Mahdaiya ...	Do ...	Large ...	Compact 3" × 5"	Tall ...	Injured by rats.	

	Type.	Name of variety.	Locality.	Colour of grain.	Size of grain.	Character and size of head.	Plant.	Threshing.	Remarks.
41	Evidently all crossed.	Arara ...	Hamirpur.	Yellow...	Very small.	Compact under $2\frac{1}{2}'' \times 4''$	Tall ...	Easy.	Nos. 41, 42 and 43 are also of the same type as above but showed evident crossing in the progeny, no 41. Producing, (a) heads as per parent, (b) heads with grains whitish-yellow and purplish glumes and (c) heads with large and whitish-yellow grain. In 42 and 43 the progeny showed a slight tinge of red in the grain.
42		Dugdi, yellow	Banda ...	Pinkish-yellow.	Medium	Compact to loose $3'' \times 6''$	Do. ...	Easy.	
43		Karsia ...	Do. ...	Pinkish-yellow.	Do.	Compact to loose $3'' \times 5''$	Do. ...	Easy.	
44	White double-grained heads.	Sufed Dohra	Jalaun...	Yellowish-white.	Small ...	Compact $4'' \times 6''$	Short	Somewhat difficult.	Nos. 44 to 50 both inclusive seem to belong to a variety having white double-grained heads as the type, possibly short and compact. Many of them show evidence of crossing with a yellow-grained variety. Thus in No. 47, the progeny gave compact heads with white grain and large loose heads with yellowish-white grain. Nos. 48 and 49, though the parents, had yellowish-white grained heads, threw many a progeny with distinct white grain. No. 50 showed in the progeny glumes with a purplish tinge.
45		Desi ...	Banda ..	Yellowish-white.	Medium	Compact $3'' \times 4\frac{1}{2}''$	Do.	Somewhat difficult.	
46		Baidra ...	Hamirpur.	Yellowish-white.	Do.	Compact $3'' \times 6''$	Short thin (tall).	Somewhat difficult.	
47		Ujjar ...	Banda ...	Yellowish-white.	Very small.	Compact $3'' \times 5''$	Tall ...	...	
48		Dugdi, white	Do. ...	Yellowish-white.	Small ...	Compact to compact $3'' \times 5''$	Do. ...	Somewhat difficult.	
49		Alagardi ...	Do. ...	Yellowish-white.	Medium	Compact to loose $2\frac{1}{2}'' - 3 \times 4\frac{1}{2}'' - 6''$	Do. ...	Somewhat easy.	
50		Bauni ...	Hamirpur.	White	Do.	Compact $3\frac{1}{2}'' \times 6''$	Do. ...	Somewhat easy.	
51	Red double-grained heads.	Lal Dohra ...	Jalaun ...	Red (base slightly yellowish).	Medium	Compact to loose $3'' \times 7''$	Short (tall).	...	No. 51 appears a distinct variety with deep red double-grained heads as the type. It produced some progeny with grain less deep red.

Sub-group (b) Glumes with little hair, hard, portion glabrous, shining, purple or black, small, fully exposing grain, upper glumes slightly keeled, grain single, medium, hard, very difficult to thresh.

52	Miscellaneous	Unknown.	Yellowish.	Small ...	Compact to loose 2" x 5"	Red to purplish shining.	(Tall) ...	The original plants were odd heads picked out of plots and differing from the main crop the name of which was not noted. It is evident from the progeny that cross-fertilization freely took place. Nos. 52 and 53 showed the greatest variation in the progeny, i. e., large spreading heads or compact with glumes more or less hairy or nearly altogether bare and shining, having various shades of purple, red and yellow. The grain being yellow, yellowish-white and in one head both white and yellowish-white. No. 54 showed somewhat less variation. No. 55 resembled parents except that the glumes in some cases were more hairy, and the upper glumes not keeled at all.
53	Miscellaneous	Do. ...	Yellow	Do. ...	Compact 2" x 6"	Reddish purple shining	(Tall) ...	
54	Miscellaneous	Do. ...	White ...	Do. ...	Compact 3" x 5"	Black shining.	...	
55	Miscellaneous	Do. ...	Yellow...	Do. ...	Compact to loose 2" x 5" — 6"	Purplish black	Tall (thin).	

CHAPTER IV. MISCELLANEOUS.

Seed inoculation with the tubercle-forming bacteria of gram.—

Sufficient seed to sow twelve plots, each one-eighth of an acre, was inoculated. The experiment was carried out in duplication on two varieties of Bundelkhand soil, i.e., *rákar* and *parwá*. The media was prepared by myself from early-sown gram having a good supply of root nodules. Check experiments which demonstrated the efficiency of the material were carried out at Cawnpore and will appear in that report.

The following statement shows the outturn of gram in lbs. per acre on inoculated and uninoculated plots:—

Parwá.			Rákar.			Remarks.
Serial No.	Treatment.	Outturn per acre in lbs.	Serial No.	Treatment.	Outturn per acre in lbs.	
1	Inoculated ...	*584	1	Inoculated ...	420	There should have been eight plots on <i>rákar</i> , this being the poorest soil, but owing to a misunderstanding only four were prepared.
2	Uninoculated ...	1,030	2	Uninoculated ...	440	
3	Inoculated ...	1,050	3	Inoculated ...	471	
4	Uninoculated ...	1,045	4	Uninoculated ...	440	
5	Inoculated ...	*697				
6	Uninoculated ...	*661				
7	Inoculated ...	1,030				
8	Uninoculated ...	1,004				

The common blue Agave as a famine fodder (*Agave lurida synvera-cruwz*).—Bulbils were planted out in August of 1906. They do not seem to have gathered strength to carry them very successfully through the blighting hot winds of Bundelkhand in May and June. It is possible that suckers may be more successful, and these have been put down this year. The question of the utilization of this Agave for purposes of fodder in years of famine was recorded in last year's report. Further experiments in this connection have been carried out at Cawnpore and the results are recorded in the report of that station, but the possibility of animals living for some months on the leaves of this plant when properly prepared with a little *bhusa* may be taken as settled.

Spineless cactus (*Opuntia ficus indica*).—The propagation of this plant as a possible fodder in times of famine is being continued. It will take probably two or three years before sufficient plants have been obtained to commence any feeding experiment. The utilization of the ordinary cactus with spines has existed in Texas and Mexico on ranches during prolonged seasons of drought since before the civil war, the spines being scorched off with lighted brush wood. Feeding experiments have recently been carried out there, and experiments with gasoline lamps for burning off the spines are under trial. The removal of the thorns with fire and the utilization of cactus in times of famine is not unknown in these Provinces.

The selection of wheat for resistance against the rusts *P. glumarum* and *P. triticeii*.—One hundred and twenty kinds of wheat were sown consisting of I Wheats received at different times from the late Mr. Farrer, II Crosses between Mr. Farrer's wheats and Provincial wheats III Crosses between Provincial wheats, IV Crosses between Russian and Provincial wheats, V Crosses between Russian and Mr. Farrer's wheats : these had been selected at Cawnpore in the past for a combination of rust drought and resistance. The year was a favourable one for the disease, and they all rusted badly. One plant, a poor specimen from F. (S).² × Ulka bald, (a cross between Russian and one of Mr. Farrer's wheats) appeared to be practically rust free. In addition to this one some twenty-nine plants as noted below were selected from Mr. Farrer's wheats as being less affected than the rest. Many of the parents of these, (as their names imply) went originally from this country, were selected or crossed by Mr. Farrer and the progeny returned under the following names:—

Plants selected 1907.

Etawah A	...	...	8
Fifes Indian	...	...	2
Indian H	...	...	5
Indian H'	...	...	3
Muzaffarnagar bald ..	...	...	6
Sirdar × Zaff	...	...	1
Sirdar × Zaff × Zaff	...	...	4

In addition to the above, wheats were collected in small lots from all parts of the Provinces and were sown for the first time in the year under report with the hope that, amongst so wide a collection, something might be found showing rust resistance. Some two dozen plants were selected as showing least affection, but none proved actually free from disease. A wheat received from a zamindar at Kalpi, and reported as having proved rust resistant for ten years, or rather perhaps never noticed badly attacked during that time, proved to be the ordinary Red Pisia and rusted in the same degree as the others.

With taking over charge of the work last year I have endeavoured to arrange conditions so as to induce rust and thus test, as severely as possible, the real powers of resistance of the plants under selection. I hope to do this by not only freely irrigating but also by sowing intervening rows with any wheat particularly liable to rust, thus forming centres for the spread of the disease, and by arranging for shade so as to retain the morning dew as long as possible on the leaves and so give every chance for the spores germinating and infecting other plants. To obtain this in the simplest and cheapest way I have, in the kharif, sown castor in rows about eleven feet apart. As the castor increases to a suitable height the lower leaves will be stripped off, thus allowing, it is hoped, the very necessary free circulation of air for the distribution of spores by wind while retaining the upper leaves as shade.

Linseed Rust.—No work in this connection could be done as no rust except a few spots on the country plants occurred. The alleged resistance of the Russian, Australian and Dutch varieties also remained untested in consequence.

Kans-killing.—The experiment of flooding *kans*, &c., for the purpose of killing it was not possible to carry out effectively during the past year owing to the water in the *Bamba* being cut off permanently during the kharif season.

Trial of implements.—Some tentative trials with various implements have been made. Two or three forms of ploughs to facilitate working in land infested with *kans* are under trial.

The question of boring for water in the heavier soils of Bundelkhand presents special difficulties. The question of the most suitable tool for this purpose is being tested.

The comparative results between broadcasting and sowing cotton with the Surat drill are herewith shown. The drill requires practice and experience both in man and cattle. But owing to the character and shortness of the sowing season in the kharif not much can be done at this time. Moreover the kind of cotton sown, the rapidity with which seed can be put in with the *bakhar* and the general excellence of the germination if the weather is at all favourable leave little room for improvement. And if drilling is possible some adaptation of this better implement to the purpose seems most likely to succeed.

Comparative outturns of Drill *versus* Broadcast duplicated on four plots in *parwá* :—

Serial number.	Name of variety with method of sowing.	Outturn in lbs. per acre.	
		Parwá.	Kabár.
1	Jalaun Kapas (Drill) ...	184	164
2	Do. (Broadcast)	374	194
3	Do. (Drill) ..	61	148
4	Do. (Broadcast)	287	169

Distribution of seed.—Small quantities of maize, ground-nuts, juar, rice and oats were distributed locally.

Bulls.—Two or three bulls have been kept throughout the year. They were allowed to serve any cows brought to the station, and from time to time are sent out to graze with village herds.

Statement showing the average outturn per acre of rabi crops during the year 1906-07 and the area from which the average has been taken:—

Crops.	Már.		Kabár.		Parwá.		Rákar.	
	Area in acres.	Outturn in lbs. per acre.	Area in acres.	Outturn in lbs. per acre.	Area in acres.	Outturn in lbs. per acre.	Area in acres.	Outturn in lbs. per acre.
Pissia wheat and gram ...	5.66	*453	2.84	*576	1.50	*480	...	...
Kathia wheat and gram...	7.38	382	5.49	394	...	...	1.86	303
Gram ...	...	...	.28	661	1.04	783	2.65	369
Oats ...	1	*297	.33	*291	.16	*641	...	...

* These are irrigated once by canal water.

CAWNPORE :

The 4th of September 1907.

J. M. HAYMAN,

Deputy Director of Agriculture.

APPENDIX A.

Character of the season and rainfall.—The monsoon broke on the 23rd of June, earlier than in recent years, and by the end of the month gave a good rainfall of 9·16 inches—more than ample for ploughing and sowing purposes—but it continued to rain up to July the 13th with the exception of four days between the 3rd and the 8th. From the 13th to the 20th, both inclusive, a good break occurred which enabled sowing to be finished up. It began to rain again on the 21st and continued till the 13th of August, when another favourable break occurred between this date and the 24th, allowing time and opportunity for ploughing rabi fields and weeding kharif crops. The greater part of September was wet with a break of nine days in the middle. The rain in the earlier part of this month damaged slightly cotton, til and bajra, and during the latter half its continuance up to the end of September delayed rabi sowings; grain remained dear and fever continued bad throughout the season. During the winter season no frost occurred, but rain and cloudy weather in February gave rise to a certain amount of rust. In some places hail did severe damage.

Rainfall from June 1st, 1906, to May 31st, 1907.

Month and date.	Total per day.	Total per month.	Month and date.	Total per day.	Total per month.
1906.			September 4th...	1·10	
June 23rd ...	·16	9·16	" 6th...	·72	
" 25th ...	·60		" 9th...	·28	
" 27th ...	2·00		" 10th...	2·28	
" 28th ...	2·31		" 11th...	·72	
" 29th ...	4·02		" 12th...	·18	
" 30th ...	·07		" 13th...	·57	
July 1st ...	·44		" 14th...	1·13	
" 3rd ...	·31		" 15th...	·04	
" 8th ...	·80		" 17th...	·31	
" 9th ...	1·38		" 27th...	2·19	
" 10th ...	·47	10·45	" 28th...	·20	
" 11th ...	·48		" 29th...	·21	
" 12th ...	·60		" 30th...	·10	10·01
" 21st ...	1·20		October 4th...	·39	·39
" 24th ...	·03		1907.		
" 26th ...	·24		January 10th...	·30	·30
" 27th ...	·40		February 6th...	·90	
" 28th ...	2·78		" 7th...	·29	
" 29th ...	·60		" 11th...	·23	
" 30th ...	·62		" 12th...	·48	
" 31st ...	·10		" 17th...	·15	
August 1st ...	·02	4·78	" 18th...	·69	
" 2nd ...	1·23		" 19th...	·20	
" 3rd ...	·17		" 20th...	·25	3·19
" 4th ...	·17		March 12th...	·02	
" 6th ...	·14		" 16th...	·02	
" 7th ...	·01		" 18th...	·30	
" 9th ...	·30		" 22nd...	·14	
" 10th ...	1·81		" 27th...	·03	·51
" 11th ...	·46		April 12th...	·05	
" 12th ...	·07		" 13th...	·18	
" 13th ...	·01		" 14th...	·22	
" 23rd ...	·16		" 16th...	·02	
" 24th ...	·20		" 27th...	·04	·51
" 30th ...	·03		May 23rd...	·11	
			" 28th...	·16	·27

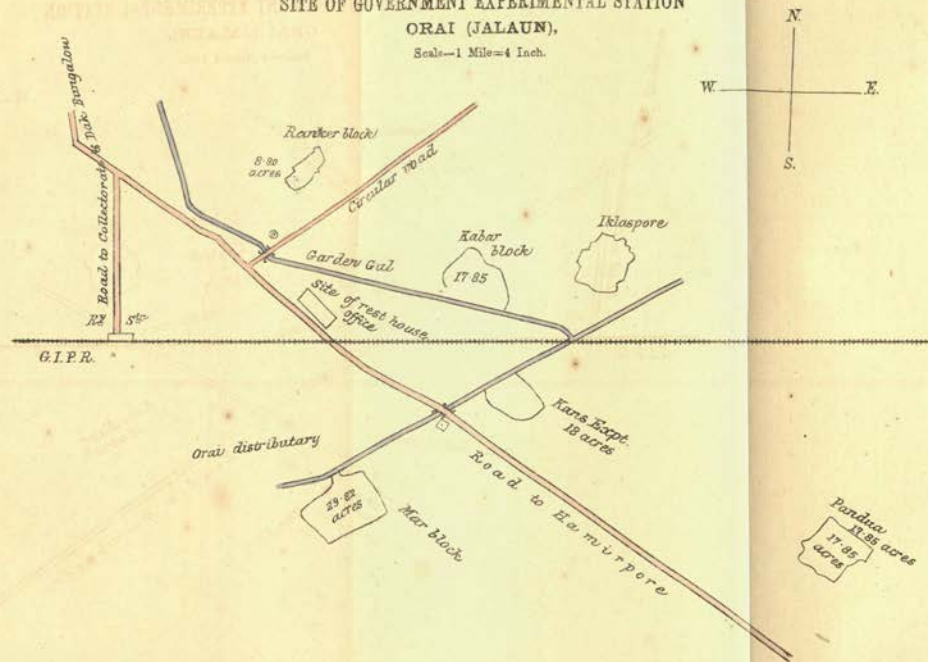
Mean temperature at the Orai Agricultural Station.

Month.				Under shade.		In the open.		Remarks.
				Maximum.	Minimum.	Maximum.	Minimum.	
June	1906	{ First-half	...	108.6	89.3	*116.8	*85	Average for 13 days.
		{ Second "	...	98.3	84.4	102.7	80.1	" 15 "
July	1906	{ First "	...	92	81	96.7	71.7	" 12 "
		{ Second "	...	92.7	80.3	99.7	78.3	" 15 "
August	1906	{ First "	...	88.8	76.8	92.2	75.8	" 15 "
		{ Second "	...	94.2	80.6	102.7	78	" 16 "
September	1906	{ First "	...	87.9	78.2	91.6	77.4	" 15 "
		{ Second "	...	90.9	74.4	91.8	72.8	" 14 "
October	1906	{ First "	...	94.8	73.2	96	68.5	" 15 "
		{ Second "	...	95.5	67.3	94.9	58.4	" 16 "
November	1906	{ First "	...	92.3	59.1	94.2	51.8	" 14 "
		{ Second "	...	82.7	52.4	102.6	43.8	" 16 "
December	1906	{ First "	...	83.9	54.4	106.3	45.8	" 12 "
		{ Second "	...	78.8	49	90.1	42.7	" 16 "
January	1907	{ First "	...	76.7	50	95.8	44.4	" 15 "
		{ Second "	...	83.1	52.1	102.6	45.5	" 16 "
February	1907	{ First "	...	78.6	53.2	90	48.7	" 14 "
		{ Second "	...	78.1	55.6	95.9	52.4	" 13 "
March	1907	{ First "	...	87.5	58.2	103.5	52.8	" 15 "
		{ Second "	...	90.5	56.6	97.9	53.5	" 16 "
April	1907	{ First "	...	97.9	67.5	102.8	63.7	" 15 "
		{ Second "	...	97.5	73.1	104.2	66.1	" 14 "
May	1907	{ First "	...	108.8	71.9	113.6	67.2	" 14 "
		{ Second "	...	110.1	81.1	113.2	76.2	" 16 "

* Average for six days only.

APPENDIX B.
M A P
SITE OF GOVERNMENT EXPERIMENTAL STATION
ORAI (JALAUN),

Scale—1 Mile=4 Inch.



NOTE—Outline of blocks and width of roads not to scale
distances and directions are practically correct.

